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AQUACULTURE RESEARCH DIRECTIONS FOR SASKATCHEWAN

by

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INTRODUCTION

When we talk about the production of fish, we are talking about competition to the production of livestock. I mean it's not that we like or don't like steak, that's not the real issue. The issue is can we afford not to have aquaculture in our mix of agriculture.

I ask the question, is the pressure for food so desperate that the only criteria will be total calories and the quality of food will have no bearing on our food production and food consumption in the future? Quite frankly I think that quality of food will not be important. The specter of overpopulation and the depletion of nonrenewable resources, the build up of contaminants and the possible failure of the world's food production systems are something we can't neglect. We can't ignore the seriousness of the trends that we see; where the world's ability to cope with man's voracious appetite must be really seriously considered.

Many people have seized on the simplistic answer to this problem in saying; animals and aquaculture species eat grains therefore we cannot have fish, cattle, livestock, grain production and a starving world at the same time. The production of rice, wheat, sorghums and other food grains is compatible with the aquaculture industry, not in competition with it. This fact must have an effect on policy makers and I'm not talking about somewhere off in the ends of the world, I'm talking about Saskatchewan. We will not feed the world population simply by eliminating livestock, that is not the answer. Of much more significance I think, is getting some grasp on the future and the abilities to produce fish, livestock or crops.

That is we can and will increase production of our crops and we will

make genetic changes but what is the cost in terms of water, fertilizer, machinery, etc.

I think too, that we can say that the availability of land has had very little effect on whether we do or do not continue to grow crops. Unquestionably that can be a factor in the future. It has been much more the market place that determines what we grow and where we grow it.

THE WORLD FOOD MARKET

We can't talk about aquaculture in isolation of what is happening in the world market for food. Estimates of the potential food production of the world have been misleading, I think seriously misleading. Although the problems of overpopulation have been very well enunciated and we still see huge population increases and they do get fed; what was misleading is that our inability to project how different regions of the world would produce food and how effective they would be in producing food. Now it's interesting that of the 900 million tonnes of product that is moving around at any one time in staple food production, only about 15% of that is trade and this was principally between the industrialized nations.

Interestingly enough, share of this amount of tonnage for the least developed countries is increasing. Now that means that either their ability to buy food is increasing or more likely their need for additional food is increasing. Some of the countries with the money resources to produce food have not been able to produce it for a variety of political reasons. Some people blame it on the OPEC oil prices, other people have of course identified it as being policy problems in the country, instabilities of governments and so forth. On the other hand, we have had certain countries which have turned from importers to exporters, even during the phase of increasing population. The green revolution has reached them. So we have had a very disproportionate technological transfer and there are many reasons for that failure.

THE POTENTIAL FOR FISH

Let me now turn to the limitations of fish production. What are the limitations? The horizons for biological improvement and biological progress are expanding at a rate that even those who are professionals in the area can hardly cope with the changes that are occurring.

Because some of the developments that are coming on stream now or that we can see down the road are so dramatic that we really don't know what the potential to produce food is. But nevertheless there are some state-of-the-art principals which I think we have to recognize if we're looking into the future.

The biological system has finite limits: there is only so much efficiency that you can build into a system. There are losses in fish, for instance, the loss of body heat, and the loss of heat while digesting food. These are losses that we can minimize but we cannot eliminate, so we have then a built in efficiency, so that when an animal is born it's working at about the maximum that any biological system can work, which is about 35%. That decreases as the animal ages because of a lot of factors that are imposed upon an adult animal.

The second limitation I would like to talk about is that any production system may not achieve its optimum biological gains. Let me give you an example, an ideal barn temperature is economically feasible for poultry and swine under present circumstances with the present cost of feed, heating and so forth. But in the case of beef cattle, we avoid even moderately the costly housing or feed to keep the animal warm. In one you are feeding straight grain and the other one you are feeding a high level of roughages at a much lower price.

Third, there are fixed overhead costs in fish production systems, such as the cost of breeding stock, the interest on investment and so forth. Now these can be offset to some part by increasing the productivity, and there is a tremendous ability to increase the productivity in fish production. Thus, the more fingerlings you have per female per year, or the heavier starting weights that you have for each fingerling, will therefore reduce the overhead per unit of production. So these are opportunities for us to increase, and I might say that fish production, by in large, is well behind, for instance animal or crop production, in its adapting or modernizing. However you have to be very careful because of the cost of increasing efficiencies.

Let's take a fish farm in Saskatchewan, how do you measure efficiency? A farmer in Saskatchewan or a farmer in Europe, both of whom make their money out of large acreages of fish raceways for 12 months a year. In Europe they really don't care how much the fish produces, in terms of weight, what they worry about is how many fish they get per acre. In Saskatchewan, we have an entirely different situation where we have long periods of feeding stored feeds and therefore the key measure there is productivity per animal. One is basing his work on productivity per acre, the other is basing its productivity per fish.

The efficiency of digesting plant material is really at the heart of the matter. How well does the fish digest the food material? Because roughage and carbohydrate materials is the main source of food, a great deal of our research now and in the future will be towards how we can, in fact, improve that particular aspect. How well does a fish digest the food and can you change that? You can take that food, cut it up shorter,

cut it up longer, compress it, add chemicals to it, you can do all sorts of things to it to change the way that it is digested. You do that with very high quality feed. So we have tremendous opportunities we're just really moving into.

Now the improvement in fish productivity to this point has really frustrated researchers. One of the biggest caps on our research development has been fish diseases. Across the world the cap on productivity by animal diseases has been frustrating and has really limited production. Even with our modern livestock, for instance in pigs, where probably we put more effort into intensive care of those animals than any other species and yet we lose 5-10% of our piglets at birth. You lose another group up to about 20% before you get them weaned and off to market. You can see what carrying that kind of monkey on your back does to production. We're close to a break through with the biotechnology that is coming forward now, especially with vaccines. We are going to make a development, a thrust into the system which will be at least as exciting as antibiotics. Just imagine eliminating some of these major diseases from fish so that the loss, that 20% off the top, was eliminated. Tremendous advances can be made here.

The next thing is low reproductive rates. Because of under nutrition, diseases and so forth have put a cap on our reproductive rate, and this is a great limitation. The question here is a very difficult one. As you go into increased reproduction it does imply a much higher level of management and this we have great difficulty in finding. That is, in Canada particularly we have great difficulty in finding aquaculturists with the capabilities of managing well enough to get the reproductive level up.

WHY EAT FISH

The consumption of fish protein is another aspect. I think this should be a shocker to most people. The eating of fish products fills a very important nutritional need of mankind. For high quality protein, for calories and for other essential elements that don't come readily from other sources, this is very important. You can't get them as cheap nor as pleasantly from other sources. Fish, meat and plants have a traditional complimentary position in our diet, but all people tend to eat, with certain very limited cultural exception, plants and animals. But interestingly you eat more and more fish products the more affluent you are and this seems to be a trend right across the world. Clearly in North America we eat excess animal products. To this extend almost 70% of the protein we eat comes from animal sources and 50% of the calories. We are not fish eaters, we are animal eaters. Our calories come from milk, eggs, meats and so forth, and from the fats that are associated with them. The North American situation seems to be the world trend as affluence increases you increase your animal product consumption. Will this be sustained across the decades ahead, that's a moot question.

Another point to remember is that the world's production of coarse grains is almost double that of fine grains. That is the corns, and so forth, are twice the number of bushels as for rice and wheat. That's done for very sound agronomic reasons; it isn't just cussedness on the part of the farmers that they grow one crop and favor another, they do it for very good reasons.

It's just as ridiculous to withhold grain from fish because it would block a means that we have of balancing the world market for coarse

grains. That is, production goes up and down, and demand for coarse grains does go up and down. Fish can be a levelling factor by feeding grain to livestock and fish.

Twenty years ago a lot of research went into trying to find out how to feed more and more surplus grain to steers. We fed cattle up to 90% of their intake with grain to get rid of grains. So as grain increases in price and the availability goes down, we decrease the level of grain consumption. So cattle and fish are not in competition, they complement the situation.

About a quarter of actual protein and energy that went into the dairy cow comes back out in the form of usable products. In beef it's a disaster; only 5%. Here is where the claims and condemnations come from. Pork is about equal to milk cows and poultry approaches the same level as pork, as you would expect, because they are straight grain eaters. The total system of having a cow producing milk is the dairy cow and her replacement heifer and the bull to serve her. It's a total system we're talking about now. The energy efficiency of a pig is 101% and 181% for the protein. Look at the old steer, 57% on energy and 109% on protein. So what we've got now is the answer to those dummies over in the developing world who are faced, some of them, with starvation every day but keep livestock! What a bunch of donkeys, to be so stupid when everybody in North America is standing up in the pulpits knowing that they are donkeys. Why would they allow livestock to compete with them for feed? Why, because they need animal protein, they need calories, they need a reserve food, they need certain essential nutrients they can't get any other place. So animals are complimentary to plant food at almost every

level of society.

Staple foods must be produced where the resources are located. That is, it's all very well to talk about Saskatchewan and feeding the world. You must produce the bulk of food where the land, water, labour and to some extent the markets are. The alternative which we practice here in Saskatchewan is to export grain, and then move it to markets. This requires the buyer to have money or products to exchange, sufficient to cover the input costs to the farmer, plus the transportation, elevator cost, plus a profit in every stage of the operation. We're not in the business of producing food in Saskatchewan, we're producing it for a market that can pay for it.

This simplistic kind of a rule of being able to pay for food may frustrate the people who would import food if they could get it and it certainly frustrates those of us who produce it and would like to sell it. However, nobody has come up with a better means yet of allocating resources and putting a price on it, and right now the price isn't good enough to allocate resources according to some people.

In the short run, however, you always come back to fish and livestock because in the short run fish and livestock take up the slack in the system. If there is not enough incentive in the system to export grain, fish and livestock can take up extra grain. Now economically a balance has been struck between crops, fish and animals and it has ensured the sustainability of agriculture around the world.

The reason why livestock have made a sustainable agriculture possible is because they utilize and put a dollar value on the rotational crops. If you must grow something other than rice and wheat or what

have you, that's required for agronomic reasons, then about the only way you can afford to do that is if there is some way of getting value out of that crop. In some places, they will underseed beans on rice and so forth. But in most of our areas here it means putting in some kind of a forage which then has to go through some kind of a livestock, usually beef or dairy cattle.

Another point I want to make is that animal and fish products have changed very little over time. We package it differently, cook it differently, and put salt on it differently and we transport it differently, store it differently, freeze it now or can it or whatever. The basic product is still the same. The consumer is very resistant to change. A fish packer doesn't find that his products change too much. He is serving the same old market for somebody who likes fish, pork, beef or whatever.

Basically they still want their meat and potatoes and therefore there is a resistance to change which makes me think that all of a sudden we're not going to throw livestock out of North America. For instance, we make margarine look like butter, we didn't sell margarine as a product all by itself. Why, because we like the animal product, and we didn't take to soya protein and make it a special product, we made it to look like meat, didn't sell and got too costly which is an interesting point. Crop production costs go up also and therefore protein from plant sources have not been competitors for animals, and that is an interesting point isn't it? The animals are a lot more competitive than you think.

FUTURE CHANGES

Microcomputers and the allied technology is going to dramatically change fish production. In those areas we have the people that can cope with it. One of the big problems in dairy production where you have a person there 24 hours a day is to detect when the cows are in heat and to keep their yearly cycle down to where they are calving within about 12 to 13 months. This is labour intensive. Now you can do it by computer with a temperature sensor and tell when her body temperature goes up.

How can you tell what sort of feed she should be getting in terms of her milk production. If you just take the computer and add up how much weight comes into the feed bucket and the amount of milk coming through the pipeline, there is your answer, and tomorrow she gets so much grain. That kind of thing greatly enhances the availability or the productivity of animal systems.

Biotechnology and the promise of what it is going to do for disease just blows your mind. Total male population, super growth fish, the divisions of undifferentiated embryos, this thing is just exploding in what it can do. In terms of fish improvement and so forth, we have done very little, really, with genetic improvement in fish compared to what we could do. Now we have some tools and we can really move ahead.

Studies on the digestive system and how we can alter, change and improve both the system and the input of food into the system to get maximum efficiency out of a fish body is certainly a very valuable kind of research.

Fish behaviour is a new area of research. Fish behaviour is a much more economic study than we ever thought when we first started out. For

instance, just having an animal contented is not enough to get maximum productivity. The amount, density and wavelength of light will change the productivity of animals and fish, particularly poultry. Amazingly, the difference in productivity can be changed just by changing the shape and size of pens; now happy animals are in there. For instance, take a fence and a steer in the winter time. The cattle line up with that fence and get the heat from the sun. It's interesting that they will do that and they pick up significant heat from the heat bouncing off the fence.

Air movements, sounds and stress create a problem known as Pale Soft Pork. It comes around by stress and occurs because we raise our pigs so carefully that when we load them in the truck, they get all worked up and they are not capable of handling stress. As a consequence a percentage of these pigs get into the packing plant and they come out with this grey appearance and we can't use them on the fresh retail trade.

The answer to whether we are going to have white meat produced and consumed into the foreseeable future is obviously yes. Quite clearly, fish will not only be produced but they will increase in numbers with the population increase and affluence.

CONCLUSION

There are going to be signals in the system, cost of production and so forth which may change where fish can be produced efficiently. Saskatchewan may or may not take the opportunity to produce fish. That will depend on government policy, market signals that are there, alternate benefits that farmers or entrepreneurs can see if government policy emphasizes wheat production over all other kinds of production as the Crow rate has done.

The answer for Saskatchewan is government policy.

Finally three points:

- There is a very large potential for fish production in Africa, Asia and South America. With disease control they will become big exporters of fish and that is something we have to think about in the future. It's not something that is imminent but they do have a tremendous potential there, something we must not forget. We must fill the market now.

- With tremendously sophisticated kinds of management, I suspect for the foreseeable future the volumes of fish products are going to be growing and will only be produced in North America and Europe because that is the only place we have the overall system, the packers, processors, feed industries, and the aquaculturalists to make the industry work properly. So I think they will be more or less exclusively for Europe, North America and for certain isolated little places of the world where they can mimic the kind of background we have.

- The present highly inflated land prices in North America are more than offsetting the higher levels of production efficiency we have achieved

in livestock production, therefore the direction of production of fish on this continent will depend more on government policies than on the competition for resources between cash crop and livestock.